

# MASTER OF SCIENCE IN COMPUTER SCIENCE

---

## SUPPORTING THE SECURE HALTING OF USER SESSIONS AND PROCESSES IN THE LINUX OPERATING SYSTEM

**Jerome Philippe Brock-Captain, United States Army**

**B.S., United States Military Academy, 1991**

**Master of Science in Computer Science-June 2001**

**Advisors: Paul Clark, Department of Computer Science**

**Cynthia Irvine, Department of Computer Science**

One feature of a multi-level operating system is a requirement to manage multiple, simultaneous user-sessions at different levels of security. This session management is performed through a trusted path between the user and operating system. Critical to this functionality is the operating system's ability to temporarily halt dormant sessions, thereby ensuring their inability to perform any actions within the system. Only when a session must be reactivated are its processes returned to a runnable state.

This thesis presents an approach for adding this "secure halting" functionality to the Linux operating system. A detailed design for modifying the Linux kernel, the core of the operating system, is given. A new module, allowing an entire session to be halted and woken up, is designed. A new process state, the "secure halt" state, is added. Additionally, the kernel's scheduling manager is modified to properly manage processes in the secure halt state. The research has led to the implementation of the design as a proof of concept.

This research is meant to be used in combination with other efforts to enhance the security of the Linux operating system.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORDS:** Secure Halt, Trusted Path, Secure Attention Key, Linux, Computer Security

## 3D VISUALIZATION OF TACTICAL COMMUNICATIONS FOR PLANNING AND OPERATIONS USING VIRTUAL REALITY MODELING LANGUAGE (VRML) AND EXTENSIBLE 3D (X3D)

**Michael G. Hunsberger-United States Air Force**

**B.S., Rochester Institute of Technology, 1996**

**Master of Science in Computer Science-June 2001**

**Master of Science in Systems Technology-June 2001**

**Advisors: Don Brutzman, Undersea Warfare Academic Group**

**David Laflam, USA, U.S. Army Model and Simulation Office**

**Dan Boger, Command, Control, Communications, Computers, and Intelligence Academic Group**

The military is increasingly reliant on communication networks for day-to-day tasks as well as large-scale military operations. Tactical communications networks are growing progressively more complex as the amount of information required on the battlefield increases. Communication planners require more advanced tools to perform and manage signal-planning activities. This work examines the use of 3D visualizations to assist in tactical signal planning. These visualizations are developed using Virtual Reality Modeling Language (VRML), Extensible 3D (X3D) graphics, and Distributed Information Simulation (DIS) for network connectivity.

---

## COMPUTER SCIENCE

---

These visualizations and the connectivity provide signal planners the ability to generate 3D scenarios quickly identifying problems such as frequency interference, connectivity problems, and marginal-coverage areas. Network connectivity also provides a collaborative planning environment for geographically dispersed units.

The NATO Global Hub Land C2 Information Exchange Data Model (LC2IEDM) is a semantic model designed for information passing between systems. This work also examines LC2IEDM for its ability to represent tactical communication plans and facilitate the autogeneration of 3D scenarios.

**DoD KEY TECHNOLOGY AREAS:** Command, Control, Communications, Modeling and Simulation

**KEYWORDS:** 3D Visualizations, Virtual Reality Modeling Language (VRML), Extensible 3D (X3D), Tactical Communications, Communications Planning, NATO Global Hub, Land C2 Information Exchange Data Model (LC2IEDM)

### **DYNAMIC ASSEMBLY FOR SYSTEM ADAPTABILITY, DEPENDABILITY AND ASSURANCE (DASADA) PROJECT ANALYSIS**

**Wayne S. Mandak-Major, United States Marine Corps**

**B.S., Allegheny College, 1983**

**Master of Science in Computer Science-June 2001**

**and**

**Charles A. Stowell, II-Lieutenant Commander, United States Naval Reserve**

**B.S., The Citadel, 1985**

**M.S., Central Michigan University, 1997**

**Master of Science in Information Technology Management-June 2001**

**Advisors: Luqi, Department of Computer Science**

**Man-Tak Shing, Department of Computer Science**

**John S. Osmundson, Command, Control, Communications, Computers, and  
Intelligence Academic Group**

**Richard Riehle, Department of Computer Science**

This thesis focuses on an analysis of the dynamic behavior of software designed for future Department of Defense systems. The DoD is aware that as software becomes more complex, it will become extremely critical to have the ability for components to change themselves by swapping or modifying components, changing interaction protocols, or changing its topology. The Defense Advanced Research Programs Agency formed the Dynamic Assembly for Systems Adaptability, Dependability, and Assurance (DASADA) program in order to task academia and industry to develop dynamic gauges that can determine run-time composition, allow for the continual monitoring of software for adaptation, and ensure that all user defined properties remain stable before and after composition and deployment. Through the study, a review of all the DASADA technologies were identified as well as a thorough analysis of all 19 project demonstrations.

This thesis includes a template built using the object-oriented methodologies of the Unified Modeling Language (UML) that will allow for functional and non-functional decomposition of any DASADA software technology project. In addition, this thesis includes insightful conclusions and recommendations on those DASADA projects that warrant further study and review.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORDS:** Computing, Software, Software Engineering, Software Demonstration

---

## COMPUTER SCIENCE

---

### ANALYZING INPUT/OUTPUT SUBSYSTEM SECURITY IN WINDOWS CE

**Barbara A. Pereira-DoD Civilian**

**B.S., University of Missouri - Columbia, 1995**

**Master of Science in Computer Science-June 2001**

**Advisor: Cynthia E. Irvine, Department of Computer Science**

**Second Reader: Paul Clark, Department of Computer Science**

In the past few years, mobile handheld devices have emerged as an exciting new tool for accomplishing everyday tasks. Devices with the Windows CE operating system provide flexibility for the designer in the form of customizable modules and components. With wireless capabilities and a familiar user interface, Windows CE devices are becoming popular for such tasks as inventory control and information retrieval. By enhancing the self-protection of the operating system, handheld devices could be used in more demanding environments. This thesis reviews the security redesign of operating systems and explores the applicability of such redesign to the Windows CE operating system. The existing security mechanisms in Windows CE are described, and the operating system itself is critically examined for security weaknesses, especially in the Input/Output subsystem area. Recommendations are made for improving the self-protection of Windows CE. Future work is suggested in two areas: analyzing other Windows CE subsystems in terms of security, and developing a method of authenticating a Windows CE device to a server.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORDS:** Operating Systems, Handheld devices, PDA Security, Windows CE

### METHODS FOR DETERMINING OBJECT CORRESPONDENCE DURING SYSTEM INTEGRATION

**Randolph G. Pugh-Captain, United States Marine Corps**

**B.S., United States Naval Academy, 1994**

**Master of Science in Computer Science-June 2001**

**Advisor: Valdis Berzins, Department of Computer Science**

**Second Reader: CAPT Paul Young, USA, Department of Computer Science**

Object correlation is a semantic comparison of exported entities from one system to imported entities of another. Current research in search algorithms and artificial intelligence methods for pattern matching can aid integrators in finding these matches. This thesis proposes a two-stage correlation process for resolving various kinds of heterogeneity found in legacy DoD systems in order to facilitate interoperability. A prototype built using these methods is explained, results compared to current correlation methods, and recommendations made for further improvements.

The end of the Cold War and the Defense Reorganization Act of 1986, began a new era of unprecedented cooperation among the U.S. military services and our allies. Increasingly dynamic missions have required warfighters to share information quickly and seamlessly while a decreasing defense budget has left few resources to build the infrastructure needed to implement this information exchange in legacy heterogeneous data systems. One possible solution to achieving interoperability of information systems is Young's Federated Interoperability Model. This model allows system designers to advertise the kinds of information they produce and consume and then automatically provides translation services. Before data and services can be shared, however, integrators must resolve exactly what kinds of data they are providing so that other systems in the network can decide if that data is appropriate for their use. That is the purpose of the proposed correlation algorithm.

**DoD KEY TECHNOLOGY AREAS:** Command, Control, and Communications, Computing and Software

**KEYWORDS:** XML, Interoperability, Interconnectivity, Legacy Systems, Artificial Intelligence, Correlation

## COMPUTER SCIENCE

---

### CONCEPTS, APPLICATIONS AND ANALYSIS OF A SUBMARINE BASED WIRELESS NETWORK

William G. Wilkins Jr.-Lieutenant, United States Navy  
B.S., Auburn University, 1994

Master of Science in Computer Science-June 2001

Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering

Second Reader: C. Thomas Wu, Department of Computer Science

As information technology tools continue to improve, we must take advantage of this wave by developing wise solutions to help automate many daily tasks presented onboard submarines. Java based applications and Commercial-off-the-Shelf (COTS) technology provides us low cost solutions that increase the availability and mobility of the information we seek. Small pen based computers and wireless LANS allow us to create dynamic and distributable applications that can route paperwork or fight casualties. It is imperative we take full advantage of these technologies in the design of our new submarines as well as in retrofit of our older ones.

This thesis attempts to solve a key task, Damage Control (DC) communications, by designing a Java based application known as SWIPNet (Submarine Wireless Prototyped Network). This virtual grease board application uses multicast sockets to send standard DC and crew reports to all wireless handhelds that participate in a casualty. A proposed Virginia class wireless network, known as the Non Tactical Data Processing System (NTDPS), was then analyzed to determine network efficiency in the presence of SWIPNet and 14 other submarine type network loads. Demonstrations have proven that SWIPNet provides a more efficient way to communicate and can function effectively on the NTDPS.

**DoD KEY TECHNOLOGY AREAS:** Surface/Under Surface Vehicles - Ships and Watercraft, Computing and Software, Command, Control and Communications

**KEYWORDS:** Wireless Local Area Network, Mobile Computing, Java, Pen-Based Computing, Pdas, Handheld Computers, Database, OPNET Modeler, Microsoft Access, Damage Control, Multicast Sockets, Wireless Communications